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**International Preliminary
Examination Report (IPER)
Amendments**

AMENDMENT

(Amendment according to Article 11 of the Act)

To: Mr. IMAI Junichi, Examiner, Patent Office

1. Indication of International Application:

PCT/JP03/10088

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4. Object of Amendment: Specification and Scope of
Claim

5. Content of Amendment:

(1) The description "in accordance with a first
aspect of the present invention, there is provided a

plasma resistant seal...it is possible to improve a plasma shielding effect achieved by the plasma seal." from line 19, page 2 to line 22, page 4 of the specification shall be amended to read as "in accordance with a third aspect of the present invention, there is provided a plasma resistant seal... it is possible to prevent moreover a packing/O-ring from protruding to a gap in the vacuum side so as to be broken." as shown from line 19, page 2 to line 16, page 4/1 of the amended specification.

(2) The description "In the seal in accordance with the first aspect of the present invention having the structure mentioned above, ... The plasma seal used in the compressed state has a high plasma shielding effect." from line 18, page 13 to line 26, page 14 shall be amended to read as "In the seal in accordance with the third aspect of the present invention having the structure mentioned above, ... it is possible to prevent moreover a packing/O-ring from protruding to the gap in the vacuum side so as to be broken." as shown from line 18, page 13 to line 6, page 14/1 of the amended specification.

(3) The claims 1 and 2 in Scope of Claim in page 15 shall be deleted.

(4) The claim 3 "A plasma resistant seal as

claimed in claim 1 or 2, wherein a plasma seal installation groove (4) which is shallower than a depth of a packing/O-ring installation groove (3) provided in an installation member (2) is continuously provided in a plasma irradiation side of said packing/O-ring installation groove (3), the packing or the O-ring (5) is attached to said packing/O-ring installation groove (3), and the plasma seal (6) is attached to said plasma seal installation groove (4) in a compressed state."

In Scope of Claim in page 15 shall be amended to read as "(Amended) A plasma resistant seal comprising a plasma seal (6) made of PTFE provided with a plasma resisting performance, the plasma seal being provided in a plasma irradiating side of an O-ring (5) which is made of a rubber like elastic material and serves as a main seal or a plasma resistant seal comprising a plasma seal made of a material provided with a plasma resisting performance, the plasma seal being provided in a plasma irradiating side of a packing which is made of a rubber like elastic material and serves as a main seal, wherein a plasma seal installation groove (4) which is shallower than a depth of a packing/O-ring installation groove (3) provided in an installation member (2) is continuously provided in a plasma irradiation side of said packing/O-ring installation

groove (3), the packing or the O-ring (5) is attached to said packing/O-ring installation groove (3), and the plasma seal (6), which has a flat cross sectional shape long along a diametrical direction of a seal or apparatus, that is, a plasma irradiation direction, or a round shell shape in a cross section, is attached to said plasma seal installation groove (4) in a state of being compressed."

(5) The claim 4 "A plasma resistant seal as claimed in claim 1 or 2 wherein the packing or the O ring (5) is attached to a packing/O-ring installation groove (3) provided in an installation member (2), and the plasma seal (6) is attached to a plasma irradiation side of the same installation groove (3) in a compressed state." In Scope of Claim in page 15 shall be amended to read as "(Amended) A plasma resistant seal comprising a plasma seal (6) made of PTFE provided with a plasma resisting performance, the plasma seal being provided in a plasma irradiating side of an O-ring (5) which is made of a rubber like elastic material and serves as a main seal or a plasma resistant seal comprising a plasma seal made of a material provided with a plasma resisting performance, the plasma seal being provided in a plasma irradiating side of a packing which is made of a rubber like elastic

material and serves as a main seal, wherein the packing or the O ring (5) is attached to a packing/O-ring installation groove (3) provided in an installation member (2), and the plasma seal (6), which is formed in an oblong rectangular shape in a cross section, the longitudinal direction thereof being arranged along a direction orthogonal to a plasma irradiating direction, is attached to a plasma irradiation side of the same installation groove (3) in a state of being compressed."

(6) Claim 5 as shown in page 15/1 of amended Scope of Claim shall be added.

6. List of Document Attached:

(1) Pages 2, 3, 4, 4/1, 13, 14 and 14/1 of Specification

(2) Pages 15 and 15/1 of Scope of Claim

(Pages 2, 3, 4 and 4/1)

Further, there is a case that a seal made of a polytetrafluor- ethylene (PTFE) is employed as a structure having the resistance characteristic against the plasma, in place of the rubber O-ring 51, however, since the PTFE is inferior to the FFKM and the FKM in a performance as an elastic body, a sealing performance against the atmospheric pressure is not so good.

Further as the plasma resistant seal, there have been conventionally known a structure described in Japanese Unexamined Patent Publication No.2002-161264, and a structure described in Japanese Unexamined Patent Publication No.2000-34466. However these prior arts are structured such that a composition structure of the rubber seal is improved for the purpose of improving the plasma resisting performance, and are not provided with a plasma seal in a plasma side of a main seal rubber packing as are different from the present invention.

Taking the above matters into consideration, an object of the present invention is to provide a plasma resistant seal which is excellent in both of a plasma resisting performance and a sealing performance, and

can prevent a packing/O-ring from protruding to a gap in a vacuum side.

Disclosure of the Invention

In order to achieve the object mentioned above, in accordance with a third aspect of the present invention, there is provided a plasma resistant seal comprising a plasma seal made of PTFE provided with a plasma resisting performance, the plasma seal being provided in a plasma irradiating side of an O-ring which is made of a rubber like elastic material and serves as a main seal or a plasma resistant seal comprising a plasma seal made of a material provided with a plasma resisting performance, the plasma seal being provided in a plasma irradiating side of a packing which is made of a rubber like elastic material and serves as a main seal, wherein a plasma seal installation groove which is shallower than a depth of a packing/O-ring installation groove provided in an installation member is continuously provided in a plasma irradiation side of said packing/O-ring installation groove, the packing or the O-ring is attached to said packing/O-ring installation groove, and the plasma seal (6), which has a flat cross sectional shape long along a diametrical direction of

a seal or apparatus, that is, a plasma irradiation direction, or has a round shell shape in a cross section, is attached to said plasma seal installation groove (4) in a state of being compressed.

Further, in accordance with a fourth aspect of the present invention, there is provided a plasma resistant seal comprising a plasma seal made of PTFE provided with a plasma resisting performance, the plasma seal being provided in a plasma irradiating side of an O-ring which is made of a rubber like elastic material and serves as a main seal or a plasma resistant seal comprising a plasma seal made of a material provided with a plasma resisting performance, the plasma seal being provided in a plasma irradiating side of a packing which is made of a rubber like elastic material and serves as a main seal, wherein the packing or the O ring is attached to a packing/O-ring installation groove provided in an installation member, and the plasma seal, which is formed in an oblong rectangular shape in a cross section, the longitudinal direction thereof being arranged along a direction orthogonal to a plasma irradiating direction, is attached to a plasma irradiation side of the same installation groove in a state of being compressed.

Further, in accordance with a fifth aspect of the

present invention, the plasma seal is formed in a wedge shape with a thickness larger than a length in a cross section.

In the seal in accordance with the third aspect of the present invention having the structure mentioned above, since the plasma seal made of the PTFE provided with the plasma resisting performance is provided in the plasma irradiating side of the packing/O-ring made of the rubber-like elastic material and serving as the main seal, it is possible to seal the atmospheric pressure by the packing/O-ring serving as the main seal so as to inhibit inflow of the atmospheric pressure, and it is possible to seal the plasma by the plasma seal so as to inhibit the plasma from being applied to the packing/O-ring. In this case, the packing corresponds to a broader term including the O-ring, and a cross sectional shape thereof is not limited. Further, the packing includes a structure having a sealing lip or bead. Since the packing/O-ring and the plasma seal are provided together so as to share the function, it is possible to selectively use a material suitable for the sealing performance in the packing/O-ring and a material suitable for the plasma resisting performance in the plasma seal. The seal constituted by a combination of

the packing/O-ring and the plasma seal is attached to the installation groove which is previously provided in the installation member. As a structure of the installation, the plasma seal installation groove which is shallower than the depth of the packing/O-ring installation groove is continuously provided in the plasma irradiation side of the packing/O-ring installation groove arranged in the installation member, the packing/O-ring is attached to the latter packing/O-ring installation groove and the plasma seal is attached to the former plasma seal installation groove. In accordance with this structure, since the packing/O-ring is engaged with a side wall portion of an inner surface of the packing/O-ring installation groove, and the plasma seal is engaged with a side wall portion of the plasma seal installation groove, it is possible to prevent the packing/O-ring or the plasma seal from being sucked to the vacuum side so as to be moved. In addition, since the plasma seal made of PTFE has a flat cross sectional shape long along a diametrical direction of a seal or apparatus, that is, a plasma irradiation direction, the distance before the plasma reaches O-ring is made long, whereby a plasma shielding effect can be enhanced, a compression margin can be reduced, whereby compression load can

be reduced, and a space for a groove can be made small in cross section. Further, when the plasma seal made of PTFE has a round shell shape in a cross section, since spring force is generated in PTFE, it is possible to inhibit generation of a compressive creep peculiar to resin, which is generated at a time of using resin in a state of being compressed.

Further, in the seal in accordance with the fourth aspect of the present invention having the structure mentioned above, since a plasma seal made of PTFE provided with a plasma resisting performance is provided in a plasma irradiating side of a packing/O-ring which is made of a rubber like elastic material and serves as a main seal, it is possible to seal the atmospheric pressure by the packing/O-ring serving as the main seal so as to inhibit inflow of the atmospheric pressure, and it is possible to seal the plasma by the plasma seal so as to inhibit the plasma from being applied to the packing/O-ring. Since the packing/ O-ring and the plasma seal are provided together so as to share the function, it is possible to selectively use a material suitable for the sealing performance in the packing/O-ring and a material suitable for the plasma resisting performance in the plasma seal. The seal constituted by a combination of

the packing/O-ring and the plasma seal is attached to the installation groove which is previously provided in the installation member. As a structure of the installation, the packing/ O-ring is attached to the packing/O-ring installation groove provided in the installation member and the plasma seal is attached to the plasma irradiation side of the same installation groove. In this case, when the plasma seal is compressed between the installation member and the opponent member at a time of installation, the plasma is further hard to pass through the plasma seal and thereby it is possible to improve a plasma shielding effect achieved by the plasma seal. Further, since the plasma seal arranged in the plasma irradiating side, that is, the vacuum side of the packing/O-ring is formed in an oblong rectangular shape in a cross section, the longitudinal direction thereof being arranged along a direction orthogonal to a plasma irradiating direction, the plasma seal operates as a backup ring to the packing/O-ring, so that it is possible to prevent the packing/O-ring from protruding to a gap in the vacuum side so as to be broken.

Further, in the seal in accordance with the fifth aspect of the present invention having the structure mentioned above, since the plasma seal is formed in

a wedge shape with a thickness larger than a length, instead of an oblong rectangular shape, in a cross section, the packing/O-ring is brought into close contact with the concave side of the plasma seal or somewhat expand it and thereby the packing/ O-ring generates spring force in the plasma seal to inhibit generation of creep. In addition, since the plasma seal operates as a backup ring to the packing/O-ring, it is possible to prevent moreover the packing/O-ring from protruding to a gap in the vacuum side so as to be broken.

In this case, the present application includes the following technical matters.

In other words, in order to achieve the object mentioned above, one plasma resistant seal proposed by the present application is provided with the following contents.

(1) Relevant to the first aspect and the third aspect

(1-1) A plasma seal made of PTFE having a resistance characteristic against the plasma is...

(Pages 13, 14 and 14/1)

In this case, in the first embodiment to the fourth embodiment, the description is given of the plasma seal made of the PTFE corresponding to the resin, however, it is possible to apply to a plasma seal made of the PTFE corresponding to the rubber, as far as the plasma seal has a function serving as the backup ring with respect to the O-ring.

Further, since the inventors of the present invention have carried out a plasma irradiation evaluation test, a description will be given below.

Results shown in a graph in Fig. 5 were obtained by comparing a weight reduction between PTFE (10FF) and a plasma resisting FKM (F815) after irradiating the plasma (plasma gas: O_2 , CF_4). In accordance with the results, the weight reduction of the PTFE (10FF) is less than the weight reduction of the plasma resisting FKM (F815) in both the gases so that it is possible to confirm that the PTFE is excellent in a durability.

Further, when carrying out a surface observation of the FKM in which the plasma is irradiated from the PTFE side after closely attaching the plasma resisting FKM to the PTFE, and a surface observation of the FKM

in which the plasma is irradiated directly to the plasma resisting FKM (plasma gas: O_2 , CF_4), results shown in a photo map in Fig. 6 were obtained. In accordance with the results, it is possible to confirm that the plasma resisting FKM is not deteriorated if a protection film (plate) of the PTFE exists.

Effect of the Invention and Industrial Applicability

The present invention achieves the following effects.

In the seal in accordance with the third aspect of the present invention having the structure mentioned above, since the plasma seal made of the PTFE provided with the plasma resisting performance is provided in the plasma irradiating side of the packing/O-ring made of the rubber-like elastic material and serving as the main seal, it is possible to seal the atmospheric pressure by the packing/O-ring serving as the main seal so as to inhibit inflow of the atmospheric pressure, and it is possible to seal the plasma by the plasma seal so as to inhibit the plasma from being applied to the O-ring. Accordingly, it is possible to effectively inhibit the O-ring from being exposed to the plasma irradiation energy so as to be deteriorated and damaged, and it is possible to provide the plasma

resistant seal which is excellent in both of the plasma resisting performance and the sealing performance. Further, since the packing/ O-ring is engaged with the side wall portion of the inner surface of the packing/O-ring installation groove, and the plasma seal is engaged with the side wall portion of the inner surface of the plasma seal installation groove, it is possible to prevent the packing/O-ring or the plasma seal from being sucked to the vacuum side, and it is possible to hold the packing/O-ring or the plasma seal in the stable state even under the negative pressure. The plasma seal used in a state of being compressed has a high plasma shielding effect. In addition, since the plasma seal has a flat cross sectional shape, the distance before the plasma reaches O-ring is made long, whereby a plasma shielding effect can be enhanced, and a compression margin can be reduced, whereby compression load can be reduced. In this case, when the cross sectional shape is a round shell shape, since spring force is generated in PTFE, it is also possible to inhibit generation of a compressive creep peculiar to resin, which is generated at a time of using resin in a state of being compressed.

Further, in the seal in accordance with the fourth aspect of the present invention having the structure

mentioned above, since the plasma seal made of the PTFE provided with the plasma resisting performance is provided in the plasma irradiating side of the packing/O-ring made of the rubber-like elastic material and serving as the main seal, it is possible to seal the atmospheric pressure by the packing/O-ring serving as the main seal so as to inhibit inflow of the atmospheric pressure, and it is possible to seal the plasma by the plasma seal so as to inhibit the plasma from being applied to the packing/O-ring. Accordingly, it is possible to effectively inhibit the packing/O-ring from being exposed to the plasma irradiation energy so as to be deteriorated and damaged, and it is possible to provide the plasma resistant seal which is excellent in both of the plasma resisting performance and the sealing performance. Further, since the plasma seal is engaged with the side wall portion of the installation groove and the packing/O-ring is engaged with the plasma seal, it is possible to prevent the packing/O-ring or the plasma seal from being sucked to the vacuum side, and it is possible to hold the packing/O-ring or the plasma seal in the stable state even under the negative pressure. The plasma seal used in a state of being compressed has a high plasma shielding effect. Especially, since

the plasma seal is formed in an oblong rectangular shape in a cross section and the longitudinal direction thereof is arranged along a direction orthogonal to a plasma irradiating direction, the plasma seal operates as a backup ring to the packing/O-ring, so that it is possible to prevent the packing/O-ring from protruding to a gap in the vacuum side so as to be broken.

In this case, when the cross sectional shape of the plasma seal is formed in a wedge shape as in the fifth aspect of the present invention, since the packing/O-ring is brought into close contact with the concave side of the plasma seal or somewhat expand it, the packing/O-ring generates spring force in the plasma seal to thereby inhibit generation of creep. In addition, since the plasma seal operates as a backup ring to the packing/O-ring, it is possible to prevent moreover the packing/O-ring from protruding to a gap in the vacuum side so as to be broken.

Scope of Claim

1. (Deleted)

2. (Deleted)

3. (Amended) A plasma resistant seal comprising a plasma seal (6) made of PTFE provided with a plasma resisting performance, the plasma seal being provided in a plasma irradiating side of an O-ring (5) which is made of a rubber like elastic material and serves as a main seal or a plasma resistant seal comprising a plasma seal made of a material provided with a plasma resisting performance, the plasma seal being provided in a plasma irradiating side of a packing which is made of a rubber like elastic material and serves as a main seal, wherein a plasma seal installation groove (4) which is shallower than a depth of a packing/O-ring installation groove (3) provided in an installation member (2) is continuously provided in a plasma irradiation side of said packing/O-ring installation groove (3), the packing or the O-ring (5) is attached to said packing/O-ring installation groove (3), and the plasma seal (6), which has a flat cross sectional shape long along a diametrical direction of a seal or apparatus, that is, a plasma irradiation direction,

or a round shell shape in a cross section, is attached to said plasma seal installation groove (4) in a state of being compressed.

4. (Amended) A plasma resistant seal comprising a plasma seal (6) made of PTFE provided with a plasma resisting performance, the plasma seal being provided in a plasma irradiating side of an O-ring (5) which is made of a rubber like elastic material and serves as a main seal or a plasma resistant seal comprising a plasma seal made of a material provided with a plasma resisting performance, the plasma seal being provided in a plasma irradiating side of a packing which is made of a rubber like elastic material and serves as a main seal, wherein the packing or the O ring (5) is attached to a packing/O-ring installation groove (3) provided in an installation member (2), and the plasma seal (6), which is formed in an oblong rectangular shape in a cross section, the longitudinal direction thereof being arranged along a direction orthogonal to a plasma irradiating direction, is attached to a plasma irradiation side of the same installation groove (3) in a state of being compressed.

5. (Added) A plasma resistant seal comprising a plasma seal (6) made of PTFE provided with a plasma resisting performance, the plasma seal being provided in a plasma

irradiating side of an O-ring (5) which is made of a rubber like elastic material and serves as a main seal or a plasma resistant seal comprising a plasma seal made of a material provided with a plasma resisting performance, the plasma seal being provided in a plasma irradiating side of a packing which is made of a rubber like elastic material and serves as a main seal, wherein the packing or the O-ring (5) is attached to a packing/O-ring installation groove (3) provided in an installation member (2), and the plasma seal (6), which is formed in a wedge shape with a thickness larger than a length in a cross section, the longitudinal direction thereof being arranged along a direction orthogonal to a plasma irradiating direction, is attached to a plasma irradiation side of the same installation groove (3) in a state of being compressed.